IEM's AI Modeling: Short-term COVID-19 Projections
Date: 9/8/21

Leveraging over 15 years of support to HHS for medical consequence modeling and our proprietary artificial intelligence (AI) models, IEM believes that our Coronavirus model outputs can be used to assist localities and their medical facilities to better prepare for an increase in hospitalizations, to better plan for and locate drive-through testing facilities, and to determine where increased levels of transmission may be occurring.

We have been refining our AI model over the past month and are confident in its ability to provide accurate 7-day projections that can be used for operational and logistical planning.

AI-based Model Background
IEM is currently using an AI model to fit data from various sources and project new cases of COVID-19. We do not assume the average number of secondary infections (R-value) stays the same over time. IEM's AI model finds the best R-value over time to evaluate how it changes over the course of the outbreak. The IEM modeling team is running ~11 million simulations to fit each state's data and using the best fit for the R-value to project new cases over the next 7 days. The AI models are executed on a daily basis to evaluate the changing dynamics of the COVID-19 pandemic. Our projections have typically been within 10%, and are often within 5%, of actual confirmed cases.

The projections shown in this document are based on data pulled in as of 9/8/21 9 a.m.

Please provide any feedback or send any questions that you might have to us. We are continually updating and improving the model, so your feedback is critical.

Also, if you have more current or refined data for your State, Commonwealth or Territory that you would like IEM to factor in, please let us know.

IEM's Modeling Lead
Dr. Prasith "Sid" Baccam is a **Computational Epidemiologist expert** at IEM with more than **20 years of experience in medical consequence modeling and simulation of disease outbreaks** and medical consequences following hypothetical attacks with biological agents or emerging infectious diseases. He develops key simulation models and decision support tools at IEM, specializing in public health, disaster response, and medical countermeasures (MCM) to enhance data-driven decision making and improve modeling assumptions.

Upon receiving his **Ph.D. in Applied Mathematics and Immunobiology** at Iowa State University, Dr. Baccam worked as a Postdoctoral Research Associate at Los Alamos National Laboratory where he focused on researching viral and immunological modeling. After his stint at Los Alamos, Dr. Baccam has served as Task Lead in multiple public health projects have allowed him to develop expertise as a mathematical biologist and a leader on high-performance modeling and simulation teams.

He has worked with state and local public health officials as well as Federal agencies, including **HHS**, the Centers for Disease Control and Prevention (**CDC**), and the Department of Homeland Security (**DHS**). Dr. Baccam has published numerous papers on public health response models and implications on policy and has been invited to participate in workshops and symposiums held by the Institute of Medicine (now the National Academy of Health). His modeling results have been briefed to the **Executive Office of the President** and informed two presidential policy actions.

Pennsylvania State Projections
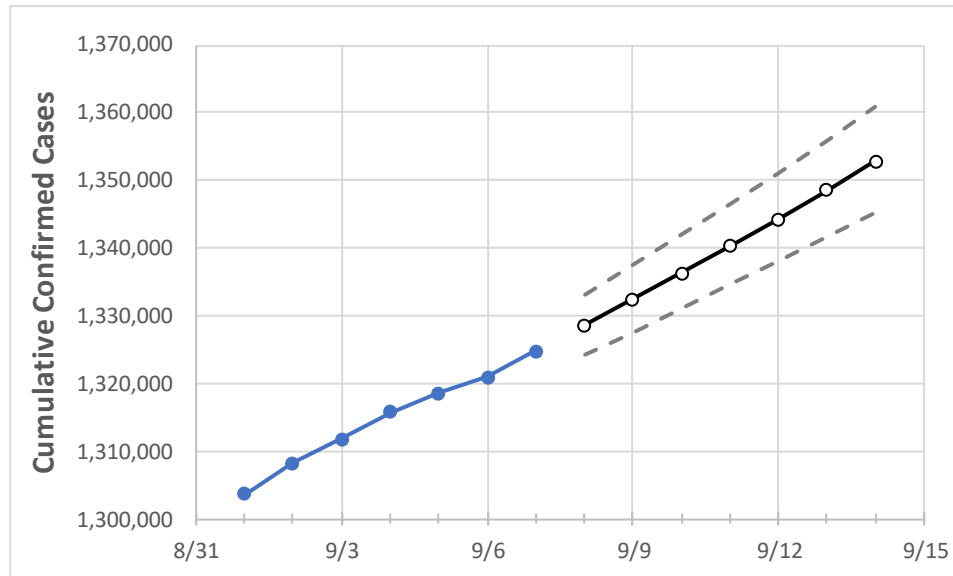
	Actual Confirmed Cases On:				Projected Cases For:						
	9/4	9/5	9/6	9/7	9/8	9/9	9/10	9/11	9/12	9/13	9/14
Pennsylvania	1,315,748	1,318,603	1,320,850	1,324,720	1,328,546	1,332,451	1,336,348	1,340,299	1,344,331	1,348,487	1,352,823

Note: The State's projection shows a "best estimate" curve (the solid line with circles) and the dotted lines are the upper and lower estimates around that best estimate. Our projections have typically been within 10%, and are often within 5%, of actual confirmed cases.

Pennsylvania Counties

	Actual Confirmed Cases On:				Projected Cases For:						
	9/4	9/5	9/6	9/7	9/8	9/9	9/10	9/11	9/12	9/13	9/14
Allegheny	111,145	111,452	111,673	111,918	112,247	112,585	112,928	113,269	113,620	113,983	114,350
Berks	51,453	51,541	51,639	51,737	51,858	51,982	52,110	52,240	52,369	52,506	52,644
Bucks	65,483	65,599	65,718	65,813	65,966	66,120	66,276	66,433	66,594	66,760	66,927
Butler	19,464	19,538	19,602	19,662	19,756	19,852	19,953	20,051	20,158	20,268	20,379
Chester	44,300	44,394	44,489	44,583	44,706	44,828	44,950	45,078	45,206	45,336	45,471
Delaware	56,327	56,431	56,505	56,601	56,744	56,884	57,026	57,171	57,320	57,473	57,626
Lackawanna	19,693	19,721	19,749	19,784	19,831	19,876	19,924	19,973	20,022	20,076	20,128
Lancaster	60,214	60,389	60,572	60,700	60,898	61,100	61,306	61,515	61,730	61,946	62,170
Lehigh	43,208	43,282	43,344	43,391	43,501	43,613	43,719	43,833	43,949	44,062	44,176
Luzerne	34,368	34,454	34,500	34,548	34,635	34,721	34,810	34,902	34,995	35,089	35,188
Monroe	16,414	16,455	16,483	16,526	16,583	16,640	16,701	16,760	16,823	16,885	16,950
Montgomery	76,312	76,473	76,629	76,751	76,945	77,138	77,330	77,530	77,725	77,937	78,135
Northampton	39,208	39,330	39,402	39,457	39,558	39,661	39,763	39,862	39,966	40,073	40,178
Philadelphia	167,214	167,464	167,715	167,965	168,274	168,614	168,921	169,253	169,568	169,900	170,214
Westmoreland	37,202	37,293	37,341	37,406	37,519	37,629	37,744	37,859	37,974	38,096	38,212
York	51,117	51,283	51,406	51,588	51,776	51,968	52,162	52,366	52,579	52,786	53,010

Some recipients of our daily COVID-19 short-term (7 day) projections have requested projections of demand for: hospital bed, intensive care unit (ICU) beds, and mechanical ventilation. We realize that different states and localities will have different characteristics for hospital demand of COVID-19 cases, and we are presenting the best assumptions we could find for those medical demands based on scientific literature and health data reporting. Specifically:

- *Beds: For hospitalization, we use a range of 10% and 20% of cases require hospitalization based on CDC's report (MMWR, March 18, 2020) and state reports of COVID-19 cases.*
- *ICU: The CDC report found that 24% of hospitalized cases require ICU care.*
- *Ventilators: Based on clinical data from China and state reports, we assume that 50% of ICU cases require a ventilator.*

If you have other estimates for these assumptions, please share them with us as we work to refine our modeling, assumptions, and data on a daily basis.

*The medical demands shown in the table assume 20% of **cumulative** confirmed cases require hospitalization. To get the medical demand for the assumption that 10% of confirmed cases require hospitalization, simply divide the demand by 2.*

Pennsylvania Medical Demands by County

	Actual Confirmed Cases On:				Projected Cases (Hospitalized) [ICU] {Ventilator} For:		
	9/4	9/5	9/6	9/7	9/9	9/11	9/13
Allegheny	111,145	111,452	111,673	111,918	112,585 (22,517) [5,404] {2,702}	113,269 (22,654) [5,437] {2,718}	113,983 (22,797) [5,471] {2,736}
Berks	51,453	51,541	51,639	51,737	51,982 (10,396) [2,495] {1,248}	52,240 (10,448) [2,508] {1,254}	52,506 (10,501) [2,520] {1,260}
Bucks	65,483	65,599	65,718	65,813	66,120 (13,224) [3,174] {1,587}	66,433 (13,287) [3,189] {1,594}	66,760 (13,352) [3,204] {1,602}
Butler	19,464	19,538	19,602	19,662	19,852 (3,970) [953] {476}	20,051 (4,010) [962] {481}	20,268 (4,054) [973] {486}
Chester	44,300	44,394	44,489	44,583	44,828 (8,966) [2,152] {1,076}	45,078 (9,016) [2,164] {1,082}	45,336 (9,067) [2,176] {1,088}
Delaware	56,327	56,431	56,505	56,601	56,884 (11,377) [2,730] {1,365}	57,171 (11,434) [2,744] {1,372}	57,473 (11,495) [2,759] {1,379}
Lackawanna	19,693	19,721	19,749	19,784	19,876 (3,975) [954] {477}	19,973 (3,995) [959] {479}	20,076 (4,015) [964] {482}
Lancaster	60,214	60,389	60,572	60,700	61,100 (12,220) [2,933] {1,466}	61,515 (12,303) [2,953] {1,476}	61,946 (12,389) [2,973] {1,487}
Lehigh	43,208	43,282	43,344	43,391	43,613 (8,723) [2,093] {1,047}	43,833 (8,767) [2,104] {1,052}	44,062 (8,812) [2,115] {1,057}
Luzerne	34,368	34,454	34,500	34,548	34,721 (6,944) [1,667] {833}	34,902 (6,980) [1,675] {838}	35,089 (7,018) [1,684] {842}
Monroe	16,414	16,455	16,483	16,526	16,640 (3,328) [799] {399}	16,760 (3,352) [804] {402}	16,885 (3,377) [810] {405}
Montgomery	76,312	76,473	76,629	76,751	77,138 (15,428) [3,703] {1,851}	77,530 (15,506) [3,721] {1,861}	77,937 (15,587) [3,741] {1,870}
Northampton	39,208	39,330	39,402	39,457	39,661 (7,932) [1,904] {952}	39,862 (7,972) [1,913] {957}	40,073 (8,015) [1,923] {962}
Philadelphia	167,214	167,464	167,715	167,965	168,614 (33,723) [8,093] {4,047}	169,253 (33,851) [8,124] {4,062}	169,900 (33,980) [8,155] {4,078}
Westmoreland	37,202	37,293	37,341	37,406	37,629 (7,526) [1,806] {903}	37,859 (7,572) [1,817] {909}	38,096 (7,619) [1,829] {914}
York	51,117	51,283	51,406	51,588	51,968 (10,394) [2,494] {1,247}	52,366 (10,473) [2,514] {1,257}	52,786 (10,557) [2,534] {1,267}

For additional information from IEM, please contact Bryan Koon, Vice President of Emergency Management and Homeland Security at bryan.koon@iem.com or 850-519-7966 or Stephanie Tennyson at stephanie.tennyson@iem.com or 202-309-4257.